Decarbonised Electricity System Study: Scenario Framework Consultation

Summary of consultation responses, 24 July 2027

Executive summary

This report summarises the feedback received to the consultation on the scenario framework for the Decarbonised Electricity System Study's (DESS) techno-economic modelling. It also presents a list of updates to the study design based on the feedback.

SEAI conducted a closed consultation with the members of the DESS Stakeholder Forum and Working Group, consisting of an online questionnaire (16 - 26 June) and an in-person workshop (22 June). The supporting document for the consultation consists of a slide deck covering key design facets of the DESS techno-economic modelling and a detailed list of draft assumptions. This can be accessed on the DESS project page.[1]

Although the absolute number of responses to the consultation are relatively low, stakeholders represent many key private and public sector institutions in the power sector with a deep knowledge of the issues covered in the consultation. The synthesised feedback below broadly reflects the range of opinions of the DESS Stakeholder Forum members.

[1] https://www.seai.ie/renewable-energy/decarbonised-electricity-system-study

Implementation environment framework axis, hydrogen, and carbon capture and storage

Overall messages

- Stakeholders broadly support 'integration complexity' as an organising concept, but the axis needs clearer definitions (including potentially renaming both the axis and tiers) and a sharper distinction between different facets of delivery risks that are considered in-scope for the axis definition.
- The strongest disagreement is around how technologies are assigned to the Self-Reliant, Connected and Enabled tiers. Some respondents interpret the distinction between Self-Reliant and Connected tiers as resting largely on a hydrogen or CO_2 network and consequently argue for hydrogen hubs and imported liquid fuels (such as hydrotreated vegetable oil, methanol, and ammonia) to be included in the Self-Reliant tier. The definition of these tiers requires clarification.
- The axis definition may benefit from including more emphasis on the risks associated with delivering technologies due to technology maturity, supply chains, and required institutional effort especially by the state (and associated institutional capacity).

Level of agreement with Likert statements

The table below summarises the overall level of agreement for each statement in the consultation.[2]

Statement	Agree	Disagree	Neutral	Overall interpretation
Integration complexity is the right organising concept for the Implementation Environment axis.	5 (71%)	1 (14%)	1 (14%)	Most stakeholders agree that integration complexity is the right organising concept, although there is a clear need to clarify the terminology.
Isolated CCS and hydrogen storage should be available at the Connected tier.	5 (71%)	1 (14%)	1 (14%)	Most stakeholders agree that isolated CCS and hydrogen storage should be available at the Connected tier.
Marine gas reservoir hydrogen storage should become available only at the Enabled tier under the high-availability trajectory.	2 (25%)	4 (50%)	2 (25%)	Stakeholder views lean towards disagreement (see discussion below).
Large-scale green methanol and ammonia deployment within the study horizon is unlikely.	4 (44%)	3 (33%)	2 (22%)	Stakeholder views are divided (see discussion below).
Direct air capture should be available at all three axis levels as a negative-emissions option.	3 (30%)	5 (50%)	2 (20%)	Views lean towards disagreement on whether DAC should be available at all three axis levels (see discussion below).
The proposed hydrogen hub locations and associated infrastructure are a reasonable representation of potential development in Ireland	0 (0%)	5 (100%)	0 (0%)	Stakeholder responding to this mostly disagree (see discussion below).
Representation of CO_2 transport via road and shipping is sufficient for this study.[3]	5 (100%)	0	0	Stakeholders generally agree that this is sufficient, but some query the inconsistency with EirGrid's long-term scenario assumptions.

[2] The 5-point Likert was reduced to three points: (dis)Agree and Strongly (dis)agree were aggregated. "Don't know" and blank responses are not included in the displayed totals.

Discussion by statement

Integration complexity is the right organising concept for the Implementation Environment axis

- Most stakeholders agree that 'integration complexity' is a useful organising concept but there is a divergence of interpretations, or confusion, on its precise definition.
- The combined feedback from the workshop and online submissions indicates that the axis should remain, but its tier definitions and technology mapping should be refined. Terminology should be clarified and broadened beyond cross-sector integration of hard infrastructure (such as hydrogen or CCS networks).
- Some stakeholders argue that the construct is useful but incomplete: the axis should capture more facets that influence delivery risks. Some stakeholders interpret 'integration complexity' as being predominantly focused on infrastructure integration, like hydrogen, CCS or heat networks (notwithstanding the provisional definition provided).
- Respondents also indicate that the descriptors for the (Cross-Sector) Implementation Environment axis, as well as the Self-Reliant, Connected and Enabled tiers, are not sufficiently intuitive without clearer definitions and examples.

Isolated CCS and hydrogen storage should be available at the Connected tier

- Most stakeholders agree that isolated CCS and hydrogen storage should be available at the Connected tier
- Some stakeholders advocate that some hydrogen storage configurations should also be available at Self-Reliant as they do not require a hydrogen network. The distinction between technology availability (within a tier) and network dependency needs to be clearer.
- Developers of hydrogen storage options note that hydrogen clusters in Cork and Dublin are the most probable and are conceived to function in isolation (no hydrogen network connecting the clusters).
- For CCS, stakeholders agree that availability in the Connected tier should be port restricted. They note that the geographic restriction should apply to all generation alternatives coupled with CCS, and not merely biomass and waste.
- Only a few stakeholders have a view on the representation of CCS transport. They agree that restricting it to road and shipping is sufficient for the study. However, they highlight that scenario input assumptions used in the modelling analysis underpinning EirGrid's future network concept design assumes CCUS and off-grid hydrogen. They question whether the DESS model should depart from EirGrid's concept grid to invest in hydrogen-enabling infrastructure.

Marine gas reservoir hydrogen storage should become available only at the Enabled tier under the high-availability trajectory

- Stakeholder views are divided about whether marine gas reservoir storage of hydrogen should only become available at the Enabled and/or lower tier.
- Some respondents argue that large geological storage should be included in the Connected tier because:
    - Marine reservoirs such as the Kinsale area fields do not require a national hydrogen network, particularly as potential peak flows are sized for local cluster needs rather than wider hydrogen-economy demand. Given that marine reservoir hydrogen storage will be deployed within isolated regional hubs, this suggests availability at Self-Reliant and/or Connected tiers.

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[3] The largest proportion of respondents to the online survey did not have a view on the matter (DK = 8), but opinion at the workshop table discussion was unanimous.

- They do not think that engineering complexity or technology immaturity of geological marine storage warrants its exclusion from the Connected tier, nor do they think that large scale marine storage requires more legislative/regulatory effort compared to LRC-hydrogen storage.
- restricting marine reservoir storage to the Enabled tier may underrepresent long-duration or seasonal storage for other scenarios, distorting least-cost model outcomes.

Large-scale green methanol and ammonia deployment within the study horizon is unlikely

- Stakeholder views are divided on whether large-scale green methanol and ammonia deployment are unlikely. Some of the disagreement rests on the distinction between indigenous and imported fuel.
- Feedback calls for the inclusion of imported methanol and ammonia. As global (or regional) commodities, availability will largely be limited by price as global production of green fuels scale.

Direct air capture should be available at all three axis levels as a negative-emissions option

- Views lean towards disagreement on whether DAC should be available at all three axis levels. Stakeholders raised concerns about cost, electricity use, and whether DAC is the appropriate negative-emissions backstop.
- Some respondents argue that DAC should not be universally available because it is expensive and electricity-intensive and could create a high shadow price of carbon that would be difficult to defend on value-for-money grounds.

Study changes

- Retain integration complexity as the organising concept but better clarify (and broaden where appropriate) the definition to include more facets explicitly as they relate to delivery risk, uncertainty or readiness.
- Indigenous production requirements will be retained for biomethane, hydrogen, and hydrogen-derived fuels (ammonia and methanol). However, for ammonia and methanol, a share of imports is permitted for a designated lead time to represent the scaling up of demand that could stimulate indigenous production investments. Document the basis for non-cost limits to any as applicable.
- Include an option for a marine geological storage to serve a local cluster in the Connected tier. The store is to be sized to serve a local cluster, rather than serve as a national-level seasonal store.

Decarbonisation axis

Overall messages

- Stakeholders generally support modelling a range of decarbonisation futures.
- The strongest consensus remains around (i) including a Paris Agreement-aligned level (with further clarifications needed) and (ii) using a scenario that doesn't reach net-zero in the power sector to compare costs and technology choices.
- Power-system net-zero-timing expectations varied substantially.

Level of agreement with Likert statements

The table below summarises the overall level of agreement for each statement in the consultation.[2]

Statement	Agree	Disagree	Neutral	Overall interpretation
Three comparably spaced trajectories with binding five-year emission limits are appropriate.	7 (58%)	4 (33%)	1 (8%)	Most stakeholders agree, but there is a substantial minority who disagree.
At least one decarbonisation level must reflect a Paris Agreement 1.5°C-consistent electricity pathway.	10 (77%)	2 (15%)	1 (8%)	A large majority of stakeholders agree that at least one level should reflect a broad Paris-aligned pathway, but further clarifications are needed.
A net-positive decarbonisation level will add value for understanding costs and technology choices.	9 (82%)	1 (9%)	1 (9%)	Nearly all stakeholders who expressed a view agree that a net-positive level would add value.
Net-positive, net-zero and net-negative trajectories together span policy-relevant futures for Ireland.	5 (42%)	5 (42%)	2 (17%)	Stakeholder views are divided on whether the three trajectories adequately span the policy-relevant futures.

Discussion by statement

Three comparably spaced trajectories with binding five-year emission limits are appropriate

- Most stakeholders agree, but there is a substantial minority who disagree. Reasons for disagreement included the following.
    - Several comments argue that the Net-Negative Emission or Net-Zero Emission tiers should not become overly constraining, especially if this increases electricity costs or slows wider electrification in heat, transport and industry.
    - Another stakeholder advocates for alignment with the proposed carbon budgets and national whole-energy-system pathways.

At least one decarbonisation level must reflect a Paris Agreement 1.5°C-consistent electricity pathway

- A large majority of stakeholders agree that at least one level should broadly reflect a Paris-aligned pathway but wanted further clarifications. Reasons for disagreement or clarification included the following.
    - Respondents who disagree (or agree broadly but want further clarifications) argue that the 1.5°C threshold has already been breached and is no longer a credible planning basis. They suggest that a 2°C pathway may now be a more useful and realistic benchmark for the most climate-ambitious scenario.

A net-positive emission decarbonisation level will add value for understanding costs and technology choices

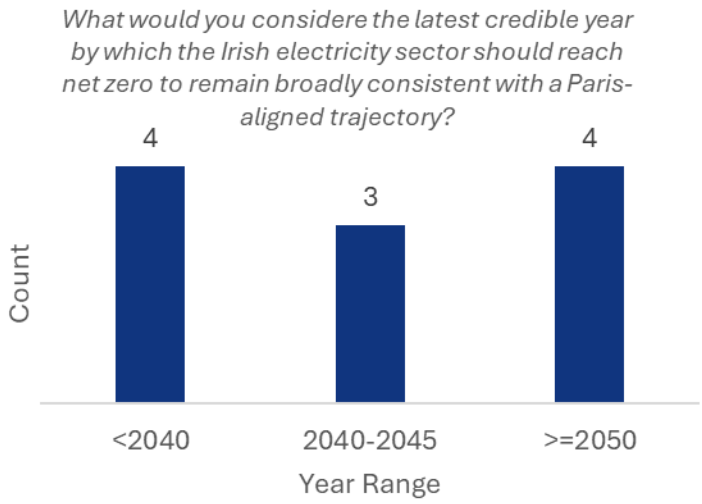
- Nearly all stakeholders who expressed a view agree that a net-positive-emissions level would add value.
    - The stakeholder who disagrees with this statement agrees that a scenario which achieves a sustainable balance between decarbonisation, affordability and security of supply would be of value.
    - They argue that a counterfactual business-as-usual pathway would be useful to demonstrate the relative costs of the other pathways.

The proposed net-positive, net-zero and net-negative trajectories together span policy-relevant futures for Ireland

- Stakeholder views are divided on whether the three trajectories adequately span the policy-relevant futures. Reasons for disagreement are as follows.
    - Some respondents feel the set should include scenarios that better test feasibility, affordability and security-of-supply trade-offs, rather than focusing primarily on decarbonisation end-states.
    - Especially, there is concern that the net-negative trajectory could raise consumer costs sufficiently to undermine electrification, while fixed trajectory points could force non-cost-optimal timing. Several comments call for a less constraining or more pragmatic pathway.
    - Conversely, others argue that at least one trajectory should be more explicitly aligned with the proposed carbon budgets, and the extant whole-energy-system modelling.

Credible date to achieve net-zero electricity

- It appears that many respondents answered this with reference to a plausible or acceptable net-zero data, rather than a strict consideration of Paris-alignment. A few respondents answered with direct reference to available data on a Paris-aligned constraint for the Irish power sector.
- Respondents provided a wide range of years by which they find it plausible or acceptable for the Irish electricity sector to reach net zero, as shown in the figure below.
- The earliest cluster of responses was 2035–2038. Qualitative feedback supporting these earlier dates emphasised the electricity sector's role as an enabler of wider decarbonisation and noted that a fully or almost fully decarbonised power system may be needed by approximately 2030–2038 for Paris-Agreement alignment.
- Responses around 2040–2045 tended to imply a pragmatic balance: maintaining ambition while recognising feasibility constraints, the need to unlock wider electrification, and the value of testing fast and slower net-zero pathways.
- Later responses, including 2050, 2055 and 2060, were generally associated with concerns about the cost and feasibility of abating the final emissions, avoiding premature constraints on the electricity system, and ensuring electricity remains affordable enough to support electrification in other sectors.



Study changes

- Retain the conceptual design of all three decarbonisation scenarios: i.e., a Net-Positive, Net-Zero and Net-Negative Emission scenarios.
- Clarify the definition of a Paris-Agreement-aligned scenario and outline the methodology used to determine it.
- Due to the sectoral boundary of the DESS, it is not possible to determine the externalities required for economy-wide decarbonisation pathways that are compliant with the Paris Agreement. Terminology such as Paris-Agreement-aligned and national Carbon-Budget-aligned scenarios will therefore not be caried forward in DESS. Instead, the final report will include a comparison of the DESS results to those assumed in other economy-wide studies that model Paris-Agreement-compliance to ensure the differences are well understood.
- Relax the upper limits for the Net-Positive Emission scenario to reflect increased electricity demand in the central demand projection.
- Select 2040 for the Net-Negative Emission scenario and 2050 for the Net-Zero Emission scenario as the latest net-zero date for the power sector.

Interconnection and fuel price assumptions

Overall messages

- Stakeholders generally agree that the presented base case interconnector capacity assumptions are reasonable, though some suggest the base case capacity is on the optimistic side, particularly with respect to 2035-2040 growth.
- With respect to commodity pricing, the carbon price received the most feedback, with many respondents questioning the need for such a high carbon price, as quoted in the draft TYNDP2026, given the inclusion of decarbonisation constraints in the scenario framework.
- There was broad agreement on the need for Irish-reflective costs where possible, with an acknowledgement that a good starting point would be to focus on variable renewable generation and battery energy storage technologies.

Level of agreement with Likert statements

Statement	Agree	Disagree	Neutral	Overall interpretation
The proposed interconnection pathway used in the base case is reasonable.	7 (54%)	6 (46%)	0 (0%)	Stakeholder views are divided on whether the interconnection capacity pathway is reasonable or too optimistic.
The proposed interconnection sensitivity capacities are sufficient to capture uncertainty in future European integration.	4 (100%)	0 (0%)	0 (0%)	A large majority of survey respondents don't know if the sensitivity capacities are sufficient.
You support the use of TYNDP 2026 fuel and carbon price projections as the central assumption set is supported.	6 (86%)	1 (14%)	0 (0%)	Most responses agree with the use of TYNDP; however, many don't know. There is acknowledgement that there are not many publicly available sources for this type of information.

Discussion by statement or question

The proposed interconnection pathway used in the base case is reasonable

- There was broad consensus between respondents on the capacity assumption 2200 MW by 2030 and the ability to increase interconnector capacity to 2950 MW.
- Some suggested it may be optimistic to assume this is delivered by 2035 and doubts were expressed at the level of capacity growth between 2035 and 2040 (from 2950 MW to 3650 MW), with some suggesting no further growth beyond 2950 MW should be assumed in the base case unless indicated by the investment model.
- Relying too heavily on interconnector imports was raised as a security-of-supply concern.
- Lead-times and supply-chain constraints for future interconnectors were raised, as was the necessary condition for any future interconnector to provide benefits to both connecting jurisdictions.

The proposed interconnection sensitivity capacities are sufficient to capture uncertainty in future European integration

- The value of the interconnector sensitivity was highlighted in two respects:
    - To quantify the additional interconnection capacity the model invests in.

    - To understand, in the case of the base interconnection capacity being limited, what potentially niche or unproven technologies selected for investment in the base case are not invested in if further interconnection is permitted.
- Most respondents replied, 'don't know' to the question, 'Are the proposed interconnection sensitivity capacities sufficient to capture uncertainty in future European integration?' and acknowledged the interdependency of interconnector investments with other capacity expansion outcomes.
- Others suggested the 2035+ 'Maximum Sensitivity Capacity' values are too high and that an overreliance should not be placed on neighbouring jurisdictions to provide capacity.
- Some felt the maximum sensitivity capacity of 6.4GW of interconnection is an overestimation and does not reflect a credible sensitivity pathway. Instead, a further interconnector to Great Britain and continental Europe would act as a plausible scenario.
- Hybrid interconnection, in particular joining southeast Ireland to southwest UK, was raised as a possibility in the 2040s timeline, however the complexity of modelling this was acknowledged.

You support the use of TYNDP 2026 fuel and carbon price projections as the central assumption set

- The majority of respondents agreed with the use TYNDP, with no other alternative source suggested.

Are there any fuel or carbon price assumptions that you believe should be revised?

- The high long-term carbon price in the draft TYNDP 2026 was questioned and there was consensus that the reason behind the carbon-price change between TYNDP 2024 and 2026 should be examined.

Are there publicly available sources that could help scale Danish Energy Agency

- It was broadly acknowledged that (i) given costs are a contested topic, (ii) there is not one source of truth, and (iii) not many publicly available alternative sources to the Danish Energy Agency, development of an Irish-specific cost catalogue with trusted data, would help bring clarity to this area.

Study changes

- The base interconnection capacity remains the same.
- Clarify that the sensitivity capacity values are options for the investment model to select, not fixed capacity input to the model.
- The parameters for the interconnection investment sensitivity are updated so that:
    - No investments (above the fixed base capacity) is possible in 2035.
    - From 2040 onwards investments to France, Great Britain and Spain are possible.
    - The candidate interconnector-investment capacity is increased from 750 MW to 1000 MW, based on feedback related to equipment trends.
- Retain TYNDP 2026 for fuel prices and employ TYNDP 2024 for carbon price.

Electricity demand

Overall messages

- Most respondents were of the opinion that the electricity requirement (TER) value selected for the core DESS scenarios should be closer to the upper bound (~90 TWh) rather than the lower bound (~60 TWh) by 2050, however views differ on the composition of this total.

- For the High Demand sensitivity, data centres and (mainly heat) electrification were the most popular growth areas suggested.

Level of agreement with Likert statements

Statement	Agree	Disagree	Neutral	Overall interpretation
The proposed TER Upper and Lower projections provide a reasonable range to represent future electricity-demand-growth uncertainty in Ireland.	3 (43%)	4 (57%)	0 (0%)	Stakeholder views are divided on whether the Upper and Lower bounds present capture a plausible range, with most disagreements focusing on the upper value and most seeking higher data centre growth incorporated.
For data centre growth, you agree that (a) the AIRAA Median scenario is the best source out to 2035 and (b) the 2050 value and locations should align with the assumptions used for the EirGrid analysis that underpins the 2050 concept transmission network design being assumed.	4 (50%)	4 (50%)	0 (0%)	Stakeholder views are divided on aligning with EirGrid, with those disagreeing wanting higher data centre growth incorporated.

Discussion by question

Do the proposed TER Upper and Lower projections provide a reasonable range to represent future electricity-demand-growth uncertainty in Ireland?

- Some respondents agreed that a TER value in the 60s represents a sensible Lower bound as it reflects the current system growth rate, though it was noted that the lowest 2050 demand level in EirGrid's *Tomorrow's Energy Scenarios 2023* is higher (low 70s).
- Other respondents focused on the Upper bound, and the need to incorporate further data centre and electrification.

What 2050 TER value (TWh) do you propose as a reasonable central estimate?

- A range of values were suggested: 60 TWh, 80 TWh (twice), 92.5 TWh (the Upper bound presented) and 100 TWh.

Do you agree that (a) the EirGrid All-Island Resource Adequacy Assessment Median scenario is the best source for Data Centre growth out to 2035and (b) the 2050 Data Centre demand value and locations should align with the assumptions used for the EirGrid analysis that underpins the 2050 concept transmission network design being assumed?

- Some respondents agreed that alignment of planning assumptions across State organisations is helpful.
- Other respondents felt that higher data centre growth should be incorporated into SEAI's study.
- Respondents acknowledged that further data-centre growth beyond contracted capacities will most likely require a plan-led approach, as indicated in the *Large Energy User Action Plan*, and that any assumption for data-centre-capacity growth beyond what is already contracted would either (i) need to implicitly assume that such growth is facilitated with electricity network expansion, or (ii) be explicitly factored into EirGrid's plans which SEAI can leverage.

What sectors (and/or) technologies should drive the proposed high demand sensitivity and what 2050 TER value (TWh) would cover a useful range to account for demand growth?

- Data centres and high electrification were the most comment demand-growth mentioned for the high-demand-growth sensitivity. E-fuel production, e.g. for aviation decarbonisation, was also suggested.
- One response suggested analysing two high-demand sensitivities, both with the same total demand but with vastly different compositions (high data centres vs high electrification) to illustrate the scale in change in outcomes due to a composition difference rather than a size difference.
- Air conditioning load was raised as a potential future growth area worthy of consideration.

Please provide any comments on the proposed demand assumptions, including alternative forecasts, evidence or data sources that should be considered.

- EirGrid's *Tomorrow's Energy Scenarios 2023* and UCC's TIM modelling as part of the Carbon Budgets Working Group 2023-2024 were cited as alternative sources to consider.
- The CRU *Large Energy Users Connection Policy* and DETE *Large Energy-User Action Plan* were cited in terms of the likelihood of large energy user capacity growth beyond what is already contracted.
- Some respondents that while capturing possible demand growth is important in long-term studies, real constraints exist, such as grid-connection (for large loads) and labour force (for heat pump retrofits).
- Clarifications were sought on:
    - the level of rail and port electrification assumed in the presented data,
    - whether green energy parks were being considered in the model, and
    - what level of flexibility is assumed from data centres?

Study changes

- Total electricity requirement (final electricity consumption plus network losses) is assumed to grow to ~ 83 TWh, 35 TWh of which comes from data centres and industrial 'Next Generation Sites', and other electricity growth and electrification assumptions sourced from SEAI's National Energy Projections.
- The updates to the High Demand Sensitivity increases the total electricity requirement to ~100 TWh by 2050.Further demand cases are explored via the two unassigned sensitivities:
- The first is assigned a Low Demand sensitivity.
- The second is assigned a High Demand Flexibility sensitivity.
- To maximise their comparative value, it is expected that all three demand-related sensitivities will be conducted on the same scenario.

Near-term portfolio and system operational constraints

Overall messages

- Most respondents agree that the starting portfolio provides a reasonable representation of generation expected to the operation by 2030
- However, many think it is too optimistic to assume operational policy will be advanced to a point that allows for the relaxation of the operational security constraints in the model by 2035.

Level of agreement with Likert statements

Statement	Agree	Disagree	Neutral	Overall interpretation
The proposed starting portfolio provides a reasonable representation of generation expected to be operational by 2030.	7 (100%)	0 (0%)	0 (0%)	Respondents agree that the starting portfolio provides a reasonable representation of generation expected to the operation by 2030.
The proposed CCGT lifetime and refurbishment assumptions are reasonable.	4 (100%)	0 (0%)	0 (0%)	Respondents agree with the assumptions; however, many others don't know.
You support the proposed 2030 operational security assumptions (95% SNSP, minimum synchronous units and residual inertia requirement).	4 (67%)	2 (33%)	0 (0%)	Most agree, however some raise possible delays to SNSP increases, as well as the need for a Dublin-specific must-run constraint.
The removal of these constraints by 2035 is a reasonable planning assumption.	2 (29%)	5 (71%)	0 (0%)	Many respondents feel it is too optimistic to remove all operational security constraints by 2035.

Discussion by statement / question

The proposed starting portfolio provides a reasonable representation of generation expected to be operational by 2030.

- Most respondents agree that the starting portfolio provides a reasonable representation of generation expected to the operation by 2030.
- Clarification is sought on:
    - how the requirements for onsite generation as part of data-centre connection policy requirements.
    - the 2030 battery energy storage portfolio assumed.
    - the synchronous condensers assumed in the model.

The proposed CCGT lifetime and refurbishment assumptions are reasonable.

- Non-neutral respondents think the assumptions were reasonable.
- Others think that 45 years for a CCGT lifetime (35 years plus 10 years extension) may be too optimistic, and that historical refurbishments should be analysed to sanity check the proposed assumption.

The proposed 2030 operational security assumptions (95% SNSP, minimum synchronous units and residual inertia requirement) are reasonable.

- There was a mixed response. More respondents agreed than disagreed.
- SNSP was the constraint that received most focus, with some respondents suggest that is the most likely constraint limit change to be delayed.

- The recent increase in minimum inertia from 23 GWs to an interim value of 28 GWs was raised an example that backward steps are possible.

The removal of these constraints by 2035 is a reasonable planning assumption.

- Most respondents think it is too optimistic to remove operational security constraints by 2035.
- It is highlighted that EirGrid and SONI's *Operational Policy Roadmap 2025-2035* are operational-policy-change targets rather than best-estimate forecasts.

Are there any known committed projects that should be included in the starting portfolio but are currently omitted, or included plant that should be omitted?

- Two projects are raised: (i) the CCGT proposed as part of (privately developed) 'Shannon LNG' project, (ii) the CCGT and OCGT units being proposed as part of the 'Derrygreenagh Power' project.

Please provide any comments on the proposed operational constraint assumptions, including alternative assumptions or evidence that should be considered.

- A Dublin-specific minimum generation constraint is suggested given the large load in Dublin.
    - The fault-ride-through issue with data centres is also raised, though it was acknowledged that it would be fair to assume this is resolved by 2035.
- The consideration of offshore wind parks in the largest single infeed-based reserve constraints, albeit it is acknowledged that large offshore wind parks may be connected to short at two nodes.
- It is suggested that a full unit commitment and economic dispatch simulation be employed to validate the outcomes from the representative periods.

Study changes

- The proposed starting conventional generation and storage fleet is retained.
- A minimum-number-of-conventional-units (MUON) constraint is added for the Dublin region.
- As a proxy for possible slippage to the milestones outlined in EirGrid and SONI's *Operational Policy Roadmap 2025-2035*, the system non-synchronous penetration (SNSP) constraint is retained in 2035.
- Clarify the inclusion of modelled reserve constraints.

Other generation and storage technologies

Overall messages

- Stakeholders broadly support the use of upper limits for less-proven storage technologies – such as Carnot battery, liquid air energy storage, iron air battery, and redox flow battery – but want the upper-cap values disclosed, justified and varied across the axis tiers.
- Stakeholders broadly support fuel availability limits for HVO and biomethane but stressed that sustainable fuel assumptions need EU-wide standards, clear evidence and careful separation from technology investment limits.
- Some stakeholders believe that the availability limits for nuclear appear overly conservative and ask that they be reconsidered.

Level of agreement with Likert statements

Statement	Agree	Disagree	Neutral	Overall interpretation
Capping less-proven storage technologies below the highest availability level is an appropriate general approach.	5 (71%)	2 (29%)	0 (0%)	Most stakeholders agree that capping less-proven storage technologies is an appropriate general principle for managing uncertainty, but this agreement is conditional on the cap values being transparent.
Fuel availability limits are the appropriate way to model HVO and biomethane in the thermal fleet.	5 (83%)	1 (17%)	0 (0%)	Most stakeholders agree that fuel availability limits are the right way to constrain investment in HVO and biomethane - fired generation in the model, though a sizeable group were uncertain and wanted clearer evidence on sustainable fuel supply assumptions.

Discussion by statement

Capping less-proven storage technologies below the highest availability level is an appropriate general approach

- Most stakeholders agree that capping less-proven storage technologies is an appropriate general principle for managing uncertainty, but this agreement is conditional on the cap values being transparent and reviewed by stakeholders.[4]
- Some respondents argue that the model should be able to select the economically optimal amount of emerging storage, because several technologies may scale rapidly and become commercially successful within the study horizon. Low or arbitrary caps could suppress useful signals.

Fuel availability limits are the appropriate way to model HVO and biomethane in the thermal fleet

- Most stakeholders agree that fuel-availability limits is an appropriate way to model HVO and biomethane in the thermal fleet, though others want clearer evidence on sustainable fuel supply assumptions as the underlying forecasting assumptions are key and could potentially impose a bias.
- In particular, the assumptions around imported low-carbon fuel limits will have a significant impact on the modelling results for the power sector, given the global nature of the market.
    - The Renewable Transport Fuel Obligation allows imported biomethane, and it's intended that the Renewable Heat Obligation will accept the same.[5]

[4] Availability caps for these technologies have not yet been developed for DESS.

- Another stakeholder seeks consistency between SEAI publications, e.g. biomethane and hydrogen assumptions in the *Heating and Cooling Assessment 2025* and the DESS.
- Participants highlight the lack of settled international standards for sustainable fuels which will complicate the setting of limits where fuels such as HVO and biomethane are imported or traded internationally.

Synthesis of open feedback on storage technology caps

- Stakeholders could not give definitive views on specific storage technologies without seeing the availability limits.
- Caps should reflect evidence such as supplier depth, global manufacturing capability, deliverability, spatial constraints, and technology maturity.
- Single-supplier risk is highlighted as a material security-of-supply issue for technologies such as liquid-air energy storage, iron-air batteries and SMR nuclear: even if deployment appears technically possible, reliance on one vendor could create serial-defect or supplier-failure risks.
- Pumped hydro is identified as needing a cap due to spatial constraints.
- Stakeholders question why lithium-ion batteries would be restricted under any scenario and suggest no cap or a very high cap, especially given movement towards eight-hour durations and beyond.
- Some respondents propose removing storage caps in the Connected tier or including a high-availability sensitivity so the model can reveal whether emerging technologies become materially useful under future market conditions.

Synthesis of open feedback on brick-based thermal energy storage

- Stakeholders are generally uncertain whether assumed boiler efficiency is a reasonable proxy for the all-in cost of gas heat when setting the switching price for brick-based thermal energy storage. There was a request to clarify the boiler-efficiency standard applied.
- One stakeholder does not consider the assumed boiler-efficiency approach to be a reasonable basis for setting the switching price for brick-based thermal energy storage. They argue that the technology should not be modelled simply as a marginal substitute for gas boiler heat. Its main system value is a power-to-heat flexibility option that can absorb low-cost, zero-carbon or otherwise curtailed renewable electricity and convert it into useful high-temperature heat. Framing the decision against the all-in cost of gas heat risks understating this value and could lead the model to overlook an important route for reducing renewable dispatch-down and supporting industrial heat decarbonisation. They propose that a more appropriate modelling approach would allow brick-based thermal storage to operate when surplus or low-value renewable electricity is available, rather than tying its operation solely to a gas boiler parity threshold.

Other generation technologies and sustainable fuels

- Waste: participants identified population growth, economics, better waste segregation, new waste separation technologies and future regulation as factors that could affect future indigenous waste availability and composition.
- Geothermal: stakeholders suggest that long-term geothermal forecasts need deeper investigation and potentially a dedicated study to provide robust limits.
- Nuclear: two stakeholders consider the deployment forecasts for SMRs and conventional nuclear too pessimistic and called for revised caps with an earliest available date of 2040, scaling to 3GW for SMRs and 3.6 GW for conventional nuclear by 2055.

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[5] DCEE submitted a Technical Regulation Information System (TRIS) notification to the European Commission seeking to subsidise domestic biomethane. In its response, the European Commission indicated that under the Renewable Energy Directive, it does not consider Ireland to be connected to the European gas network, as gas travels through the UK, and as such, can't import biomethane. Uncertainty remains around the development of biomethane import policy and accountancy.

Study changes

- Publish the proposed availability limits for the outstanding storage technologies and explain the evidence base for each cap
- Consider higher caps or uncapped storage availability for Connected and Enabled tiers.
- Reconsider whether lithium-ion batteries should be capped or restricted in Self-Reliant and Connected tiers.
- Constrain HVO and biomethane-fired generation expansion by fuel availability rather generation capacity. Consider whether there are any non-price limits to these fuel supplies that may restrict availability, and document the underlying logic
- Review nuclear availability assumptions to ensure they are not too pessimistic.